

# COLLOIDAL SOLIDS REMOVAL AND IMPROVED SEAWATER DESALTING

## BACKGROUND OF INVENTION

5 Colloidal particles or solids exist in solutions or are created by some processes, as in my patent US 6,180,012, these solids having a much larger specific gravity than the solution, still remain suspended and they would require a very long time to settle in standard depth clarifier, which would slow the processes and make it very expensive to collect and recover, and some of said solids will  
10 dissolve in the solution and be lost for recovery.

When ammonia,  $\text{NH}_3$  is mixed into seawater the CL of its salt molecules,  $\text{NaCl}$  connect to the ammonia and water, forming the compound  $\text{NaClNH}_4\text{OH}$ , (this is not understood by many professionals, not even by some professors). This  
15 weakend CL's the bond to Na in the salt compound in seawater, which then is sprayed as fine mist into a scrubber, where  $\text{CO}_2$  gas enters, seeks and connect to said Na and is breaking said salt compound apart into two colloidal solid : Soda Ash,  $\text{Na}_2\text{CO}_3$ , a valuable and salable product, and Ammonium chloride,  
20  $\text{NH}_4\text{CL}$ ., which can be recycled to  $\text{NH}_3$  for reuse in the process, and  $\text{HCL}$  an important acid for many industries. But these, being individual suspended molecules are very difficult and costly to collect and remove..

The present invention is therefore of great importance indeed, providing a  
25 practical process, at low cost, for rapid collection, removal, drainage and recycling colloidal solids, aspecially recycling of ammonia for use in said process, and therewith avoiding more production of  $\text{CO}_2$  than is removed by the process.

The present invention, also shows how to sterilize and remove organics in the seawater, as well as a practical method for removing all objectionable salt in  
30 potable seawater, and reducing  $\text{CO}_2$  emission..

## SUMMARY OF INVENTION

The above and other object and advantages are obtained in accordance with the present invention including a process or method for collecting suspended colloidal solids in a solution, for removing and drying, which is characterized by the steps :

5 a) Adding and employing iron tubes having a DC switch with double wire chord, which supply each tube with a positive charge through one wire and can be switched to a negative charge through the other wire. b) Any of said tubes having a negative charge are causing attraction and build up of said colloidal solids on their surfaces. c) One at the time of said tubes with negative charge and attached colloidal solids is moved from said solution for drainage and drying  
10 by circulating very dry air in an enclosure before the negative charge is switched to positive, loosing said tube's attraction and freeing said build up of colloidal solids, which then is blown down through an outlet for removal and easier separation and recovery of said dried material.

15 Said solution can be inside a scrubber as shown in my US patent NO 6,180,012, where colloidal solids are made and in suspension. All said tubes with closed top and bottom, will be hanging from a closed loop conveyor, mounted to brackets under a rain shield along surrounding walls of said scrubber, which has a room attached with an opening and door to said scrubber, and said closed loop  
20 conveyor has a narrow part extending into said room. One at the time of said tubes is moved into said room with negative charge and colloidal solids attached for drainage and drying. by circulating very dry air, before said door is closed and said negative charge is switched to positive, causing said colloidal solids to become loose and very dry air blows it through an outlet for removal.

25 Rotating DC outlets are mounted on a centrally located bracket near the top in said scrubber, each connect to said chord from said DC switch on top of each of said tubes. When said scrubber is too wide for use of chords, an AC receiver with a rectifier, powers said DC switch on each of said tubes. Said door from said room to said scrubber, is a nylon door rolled up over a guide shaft on a  
30 drive shaft, where top of door is connected. Strings fastened each side at bottom

of said door, extend down below door opening over a spring loaded shaft and up over said guide roller and is fasten opposite way each side of said door on said drive shaft with circular separation plates and a drive sprocket, which i is unwinding and driving down said door for closing as strings rolls up, and driving and winding up winding down said door for opening as strings unwind.

Some colloidal solids are washed down from said scrubber and is in suspension in desalted seawater in a clarifier below, which will have an overflow duct attached, with an opening near bottom of said clarifier wall connecting to said overflow duct, wherein some of said tubes are placed, having holes near top and bottom and with said DC switch, chord and a negative charge, they will

They will attract build up of said colloidal solids on the inner and outer surfaces in the streaming water. One of said tubes at the time will be lifted up above said overflow weir into an enclosure attached to said scrubber, for drainage and drying by circulating very dry air, before said enclosure's bottom is closed and said DC charge of said tube is switched to positive, freeing and blowing with very dry air said colloidal solids through an outlet for recovery.

At top of said room and said enclosure is an air fans with an air conditioning unit, for circulating very dry air up during drying of said connected colloidal solids, and blowing very dry air down for removal of said loosed built up of colloidal solids through said outlet into a large and tall tank, with cyclonic and centrifugat action and renewed DC charge for separation of air, the heavy solid and the light solid, which is used for recycling ammonia.

For further reduction of salt in my already patented process for desalination of seawater, three of said scrubbers with clarifier below, are placed closely together with said room and enclosure attached to each scrubber, and said overflow duct attached to each clarifier. All said seawater with 3 % salt compound is pumped as mist into scrubber No 1, its effluent is pumped to scrubber No 2 and its effluent is pumped to scrubber NO 3. To improve said patented process, all of the 102 %

CO<sub>2</sub> molecules needed to remove all salt molecules, will enter a bottom hole in scrubber No 3 and flow across to top hole directly to top hole in scrubber No 2 and flow across to bottom hole directly to bottom in scrubber No 1, where the remaining 96 % of the CO<sub>2</sub> molecules brake apart about 94 % of the 3 % salt compounds in said seawater. Only 2 % of said entering 102 % CO<sub>2</sub> is emitted. Said seawater with remaining 0.15 % salt compounds is pumped to scrubber No 2, where 17 CO<sub>2</sub> molecules for each salt compound molecule, are seeking and braking apart practically all of them. In Scrubber No 3 millions of CO<sub>2</sub> molecules are seeking and braking apart any remnant salt compound, leaving the effluent seawater with no objectionable salt.

Said effluent of desalted seawater still contains its plankton and other microscopic creatures , which are desirable for agricultural use, but when this is objectionable the following preprocess can be provided : The incoming seawater is sterilized by ultraviolet light, killing the organics. Said seawater is then flocculated by a vertical shaft aerator at end in a process tank with a freestanding partition.. Said aerator is throwing said seawater up and out against surrounding walls where it builds up and is forced down to the bottom and in and up at center of aerator, in a vertical spiral motion as it is being 100 % aerated and flocculated repeatedly before it is thrown into an open cannel and return to said aerator on the other side of said free standing partition. The seawater circulates many times in said tank as particles and colloidal material are absorbed by the flocks, before said seawater overflows to a clarifier , where the flock settles as sludge, which is returned to process tank many times before sludge is wasted. Said clarified seawater overflows with organics removed, to start or finish said process of my invention..

## DESCRIPTION OF SPECIFIC EMBODIMENTS

Improved processing methods, in accordance with the present invention, includes beneficial collecting and drying of heavy colloidal solids that, because they are tiny molecule size, will stay in solution during continuous process in the scrubber, where tubes of iron with negative DC are attracting and collecting colloidal solids on their surfaces. One at the time of each loaded tube is removed to an attached room and for drainage and drying with circulating very dry air before the door to said scrubber is closed and the DC charge of the tube is changed to positive and very dry air is blowing the colloidal solids through an outlet, to a settling tank for separation of said two said colloidal solids..

The process is mainly for collecting colloidal solids made and is in suspension in one or more scrubbers as shown in my US Patent No 6,160,012 for desalination of seawater. Seawater has a relative uniform salt content of about three weight percent salt. The salt is dissolved in seawater as two ions  $\text{Na}^+$  and  $\text{Cl}^-$ . The  $\text{Na}^+$  has lost one of its electrons to the  $\text{Cl}^-$ , which ties them strongly together in a ionic bond. Each salt molecule in seawater is protected by one  $+\text{H}_2\text{O}$  molecule on one side and one  $-\text{H}_2\text{O}$  molecule on the other side..

When ammonia,  $\text{NH}_3$  molecules are mixed in balanced number with salt molecules in seawater, each salt's aggressive  $\text{Cl}$  atom seek and connect to a  $\text{NH}_3$  molecule, but a water molecule is also connected there, and it holds on by transferring one of its H-atoms to the ammonia and connect its OH to the new  $\text{NH}_4$ , forming the salt compound  $\text{NaClNH}_4\text{OH}$ , which weakens  $\text{Cl}$ 's inner bond to  $\text{Na}^+$ .

The seawater with the salt compound is then sprayed as a fine mist in a scrubber, where  $\text{CO}_2$  in exhaust or pour is being added. The  $\text{CO}_2$  molecules are seeking and connecting to the Na in the salt compounds further weakening the bond to  $\text{Cl}$  and is braking the salt compounds molecule by molecule, apart into two colloidal solids :

Sodium carbonate  $\text{Na}_2\text{CO}_3$ , with specific gravity 2.58 and

Ammonium chloride  $\text{NH}_4\text{Cl}$ , with specific gravity 1.53

These two colloidal solids, in spite of being very heavy, will not settle because of their very tiny single molecule size, and they remain suspended in the scrubber. Only the present invention as shown with tubes, negatively charged, can collect and remove the colloidal solids from solution in the scrubber.

Some of the colloidal solids will be washed down by the seawater spray from the scrubber to be suspended in desalinated seawater in the clarifier below

The seawater remains cool in the process, its temperature will increase less than  $2^\circ\text{C}$  by hot exhaust gas in the scrubber, but even in this low temperature up to 7 percent of the colloidal solids may dissolve during stay in the seawater and be lost. It is therefore very important to be able to quickly

collect, remove and dry for the colloidal solid. For recovery as done in the present invention, where an overflow duct is attached to the clarifier with a connecting opening at the bottom of the clarifier's wall. The area of duct and opening must be large that flow speed of said seawater is less than 15 cm per second. In said overflow duct, said tubes are placed, with a hole top and bottom, and with a negative DC charge, they will collect colloidal solids on both inner and outer surfaces of their walls, and will not obstruct much the streaming water flow. The desalinated seawater overflows a weir at the top, for use in communities.

The speed of seawater through the opening to the overflow duct, does not prevent Magnesium hydroxide,  $\text{Mg}(\text{OH})_2$  to precipitate as sludge from the clarifier.

Seawater has about 0.3 % Magnesium chloride, but the removal of said  $\text{NaCl}$  salt sweetens and raises the pH of said seawater, its Magnesium hydroxide will therefore precipitate and be recovered..

One tube at the time with negative charge and attached colloidal solids, is lifted up above said weir, for drainage and drying in an enclosure, which is in line with said overflow duct and attached to the scrubber. After drainage and drying with very dry air circulating, the bottom of enclosure is then closed and the DC charge

is changed to positive, freeing said colloidal solids build up and blowing it with very dry air to remove adhesion, through an outlet for separation and recovery.

5 All colloidal solids being blown by very dry air through an outlet and falls into a large and tall settling tank onto a bottom screw conveyor connected to a centrifuge or other means for separation of the two dry colloidal solids. The sodium carbonate is a saleable product, and the ammonium chloride,  $\text{NH}_4\text{Cl}$ , is recovered by heating in glass lined equipment to  $250^\circ\text{C}$ , and forms ammonia gas  $\text{NH}_3$  and hydrochloric acid,  $\text{HCl}$  also a saleable product. The ammonia is  
10 recycled for use in said seawater desalination process, saving money and energy. The  $\text{HCl}$ , a strong acid is important for the metal and metallurgical industries.

My small scrubber – clarifier test unit for my patented desalination of seawater process has repeatedly shown that 95 percent of  $\text{CO}_2$  in exhaust, can be removed  
15 in one test run. But it has also shown, that the colloidal solids is very difficult to collect and recover.

The present invention as described is therefore very important as a practical method for collection and removal of colloidal solids both in said scrubbers, in  
20 said clarifiers, and in the triple unit, which shows how to produce drinkable water from seawater with my present invention also produce valuable products and remove 98 % of the  $\text{CO}_2$  gas in combustion exhaust from power plant and industrial plant and remove  $\text{CO}_2$  gas from the oil and gas drilling operation....

10 This invention has been disclosed with respect to certain preferred embodiments and it shall be understood that various modifications and variations thereof, obvious to those skilled in the art, will be included within the scope of the appended claims.